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ABSTRACT

This report discusses out-of-school science activities and programs conducted throughout the world. The discussion is organized according to type of activity and includes science camps, training periods during school breaks, scientific and technical clubs, science congresses and meetings, science fairs, and mass media instruction. (MLH)

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INTERNATIONAL COORDINATING COMMITTEE FOR THE PRESENTATION OF SCIENCE AND THE DEVELOPMENT OF OUT-OF-SCHOOL SCIENTIFIC ACTIVITIES

I. C. C.

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THE PHYSICS COMPONENT OF OUT-OF-SCHOOL SCIENCE ACTIVITIES

Working document presented at the

INTERNATIONAL CONFERENCE ON PHYSICS EDUCATION,

Edinburgh, Scotland, July 29th – August 6th, 1975

B Y

Francis L.WATTIER
Secretary-General of

I C C

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FOREWORD

The organizers of the International Conference on Physics Education (ICPE) have done us the honour of entrusting us with the preparation of a trend paper on the physics component of out-of-school science activities.

We have had to face two major obstacles :

- first of all, it is particularly hard - and even practically impossible - to collect recent and complete information and accurate figures within only few months, and above all when the inquiry is spread over the whole world ;

- secondly, and most of all, the out-of-school scientific activities are a quite new pedagogical approach in the educational process ; indeed, whilst the formal teaching of sciences dates back from ancient times, the out-of-school programmes organized within their own structures have a much recent and short history : in most countries of the world, where such programmes exist, the out-of-school pedagogy has become a fact since 10 or at the most 15 years. Of course, some rare exceptions are there to corroborate this statement.

To reply to the invitation the organizing body of the ICPE had made us last November 1974, and after few days of reflection and hesitation, we developed relations with our network of members and correspondents throughout the world. We sent them a questionnaire, that will be submitted for consideration to the participants in the out-of-school group, at the Edinburgh Conference. We are still receiving now replies, when actually the preparation of the ICC working document has been taken to an end. Consequently further information will be available after the Conference.

To synthetize our idea and view of the problem, we want to emphasize that the physics component of out-of-school science activities is still very young and the analysis of its successes and failures cannot possibly be carried out following the rigorous scientific method. But wait till the next ICPE.

1. FUNDAMENTAL CHARACTERISTICS OF OUT-OF-SCHOOL EDUCATION

The basic principles of the out-of-school "pedagogy" can be defined as follows :

- constant reference is made to creative ability to enable individual aptitudes to develop ;

- programmes are often conceived on an inter-disciplinary basis to stimulate the research into a global solution to a problem and avoid too early a specialization among young children and adolescents ;

- youth's direct participation is ensured at every level of the educative device : choice in the field of interest ; determination of methods of observation, analysis and experimental study in laboratories ; preparation of individual reports and active contribution to the elaboration of "group" reports ;

- activities are achieved not only to improve scientific and technical knowledge, but also to be integrated in socio-economic development ;

- those out-of-school scientific and technical activities gather not only school young people, but also an increasing number of non-school young people, or those who already left school like young farmers, apprentices, workers, employees, ... ;

- ...

2. THE PHYSICS COMPONENT OF OUT-OF-SCHOOL SCIENTIFIC ACTIVITIES FOR YOUTH.

2.1. Types of scientific activities

2.1.1. Science camps and training periods

The camps, tented or permanent, are mainly organized to teach application of science to nature, and to acquaint participants with the general ecology of the particular region and the place of their speciality within it : botany, zoology, physical geography, anthropology (sociology), geology, meteorology, chemistry and physics applied to nature conservation,...

These camps contribute to a large extent to foster contacts between young scientists and the interdependence of the specialities through interdisciplinary tasks.

Their success depends on various factors, in particular, the number and quality of staff ; the value and abundance of the scientific equipment ; the setting up of a working programme ; the choice of location site ; ...

Of course, it is suitable to adapt the chosen programmes and the methods used according to the origin of participants (students, young apprentices, rural young people, members of non-specialized young people associations in science activities, ...).

The various activities on the field (trips, observation material collection, ...) and in the laboratories of the camp (experimental works, group discussions, reports, presentation of the results, ...) greatly develop the sense of observation, the sense of initiative, the attitude of individual responsibility in the frame of the group's life. They bring the young people the happiness of common life, and so the richness of human contacts and the effective practice of the real dialogue, and the unity amoung young people of different horizons.

The purposes of these various camps are diversified :

- some associations organize local, regional, national or international camps, with a view to bringing a complementary training and information to the traditional formal education, the major desire of which is to have these young people discover the bases of the scientific method, the need of the observation and analysis rigor, which does not necessarily exclude the imagination richness ;

- other types of camps are directly integrated in a larger programme set up by the regional or national Authorities, principally in the frame of the plans for territory conditioning. For instance, the social factors determining the conditions of the life of populations are studied.

The training periods gather young people, mainly during the holidays, in order to work in the school, university or industrial laboratories (physics, astronautics, chemistry, biology, ...).

Themes can be usefully chosen among the important problems Humanity has to face, principally the environment pollution, the green revolution (the hunger problem), the demographic explosion, ...

Usually, it is quite difficult to determine with great precision the relative component of physics in these activities, since more often then not, they are carried out within a pluridisciplinary concept. An increasing number of countries spread over the continents, are organizing an ever increasing number of science camps and training courses.

Lacking precise statistical data, we can at least provide some very significant examples of activities in which physics is playing a priority role :

- the "Association Nationale des Clubs Aérospatiaux" (ANCS), in France, is coordinating the project development to construct and test a rocket : statement of preliminary project ; detailed study and mock-up construction ; flight model construction ; payload qualification ; actual launching ; results analysis ; ...

- the Association "Science for Children", Calcutta, is a typical example designed to stimulate an interest in science among school children. It has a hobby centre, with

facilities for the construction of simple scientific models, sections of physics, chemistry, biology and astronomy, for serious project work in these disciplines, a science library and other facilities.

- the "Summer Science Camp", organized annually by the Weizmann Institute of Science, Rehovot, Israel, has three specialized groups in physics : modern physics (theory) ; elementary particles (theory and experimental), lasers (theory and experimental)

- the "School Science Field Work Centre", of Thondaimannar Sri Lanka (Ceylon), organizes camps on improvisation of apparatus for teaching science" :

- in 1975, for example, the "Al-Ahram Science Clubs" of Egypt have organized 2 science camps which programme includes working groups on electronics, meteorology and photography, ... ;

- the Jugoslav movement "Nauku Mladima" (Youth and Science), organizes numerous camps on astronomical sciences, electronics, technical radio, astronautics, ... ;

- the "Jeunesses Scientifiques" de Belgique have free entrance in the university laboratories to hold their annual training courses in theoretical and experimental physics, as well as for their computer training courses ;

- ...

2.1.2. Scientific and technical clubs

The science club is a voluntary group of young people, the purpose of which is to allow its members to enlarge their scientific and technological knowledge by practicing the scientific method, during experimental works, discussions, debates, conferences and other activities having a scientific interest ; the publication of science information and bulletins, visits or concerns, science films shows, the making of science models and devices, the achievement of science projects, ...

The structure and work of the science clubs largely depend on the local conditions. Sometimes, they work in close relation with schools, or are completely independent ; but it is always important that the programmes of the clubs have a real science content ; the leaders of these clubs should always be informed at best of the most recent realizations in science and technology.

The are different types of clubs, principally :

the general club which covers various science branches and the members of which can be divided into working groups, mostly according to the interdisciplinary methods : physics, chemistry, biology, astronomy, astronautics, ... ;

the specialized club achieves a determined programme in a definite branch. Generally speaking, specialization of club can make its organization easier, as well as the laboratory equipment and the leader's work ;

the laboratory club is a very evolved category of science club which can include rooms for chemistry, natural sciences, physics and electronics, a mechanical engineering workroom, one (or more) room(s) for collections and very often a small astronautic observation tower in the garden.

Most of the time, the working programme is run by the young members with the guidance of adult leaders. The club's room allows young people (male and female) to meet in a frankly friendship atmosphere, and to have the opportunity of familiarizing themselves with science disciplines. Various clubs contribute to the scientific vocation awakening among young people, and emphasize the desire of developing activities in close relation with the community problems.

In the handbook prepared by Mr. R.A. STEVENS, past President of ICC, and published in 1970 by UNESCO under the title "Out-of-school science activities for young people", we can quote from the following excerpt (Page 17 of the original English version) : "...the aim of a science club is to obtain realization and acceptance of the fact that science is something which is done, not merely something which is learnt ; and also realization and acceptance of the fact that an experiment is designed and conducted to find out something which is not known, not to confirm a result which is already known in advance"....

Objectives
....

At the pre-primary and primary levels, the science clubs leaders use toys and games to stimulate curiosity among children facing environment, and their ability to recognize and become aware of science facts every time they come accross them during their activities. At this very level, the physics component is almost never an isolated fact, but is more often integrated within a general programme of activities.

At the secondary and superior levels, the clubs reach a rather sophisticated specialized degree ; at this level, young people gather in separate categories and groups. Those oriented towards physics and mechanics start then designing and building up models ; they start investigating within their own specialized groups. Here are some examples : the radio and aeromodel clubs in the USSR ; the clubs designed for to audio-visual techniques in India ; the space clubs in Singapre ; the rocketry associations in France and Chile, Poland, Spain, the U.S.A., the Federal and Democratic Republics of Germany, .. ; ...

Many a time, the participants in these activities show a keen interest in the social implications of such programmes (e.g. : study of radio-activity in water, ...)

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In the developing countries, clubs located in rural areas are also trying to develop a scientific attitude among villagers. An example is that of the SSFWC, in Sri Lanka, already mentioned previously, where the clubs try among others to build up some equipment with the material they can find directly in the village : e.g. a homemade refrigerator, ...

Other examples of typical achievements

- the clubs of cybernetics in Ukraine, are working in close collaboration with the Cybernetics Institute of the Academy of Sciences of Ukraine ; the members of these clubs have for instance designed and built up computers such as "Kostyor" and "Iskra" ;

- the Association "Estudiantes de Ciencias Luis Pasteur" in Venezuela, has since 1966 conceived the programme of its "electronics section" ;

- the Movement "Jeunes-Science" in Upper-Volta, has a particular group especially devoting itself to physics (the other group is more particularly oriented towards natural sciences) ; among the 253 members of the club, 80 % devote their work to physics. And during the "scientific fortnight" organized once a year since 1970, 45 % of the projects presented by the participants deal with physics ;

- in the U.S.A., the JETS Association (Junior Engineering Technical Society) is leading a network of clubs gathering young people particularly interested in engineering sciences and techniques. Among the activities : debates, implementation of projects, conferences, ... ;

- the laboratory-club "Jeunes-Science" in Tunisia, has among others laboratories for chemistry, natural sciences, physics-electronics, a workshop for mechanics and two collecting rooms. The various achievements are classified within three groups :

  - simple achievements, arousing youth's interest for their originality ;
  - specialized achievements (micro-photo, polarizing microscope, ...) ;
  - sophisticated important problems requiring the deep study and survey and collaboration of lecturers and specialists, teachers and technicians, during a more or less prolonged period ;

- the Association "JETS of Zambia", (Junior Engineers Technicians and Scientists) is concentrating on stimulating the interest of young people towards physics thanks and via activities and projects achieved within its clubs. The physics component is therein indeed rather important : the most developed and frequented science clubs are those dealing with radio, electronics, mechanics and aeronautics. This tendency keeps on strengthening ; the percentage of young candidates

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choosing physics reads as follows :

1972	37.8 %
1973	47.1 %
1974	51.6 %

- ...

2.1.3. Science congresses, meetings, seminars

The Latin American associations propose the following definition : these science congresses (congresos cientificos de jóvenes) are organized with the purpose of giving young people the opportunity to present science works they have set up in front of a qualified audience. The experts judge these works according to their originality, the methods applied for the work, ..., and discuss directly with the young investigators.

Other denominations are often met, e.g. :

- national or international meeting of young scientists : young people of one or various countries meet to exchange their opinions on determined science questions ; they participate, among others, in conferences on general interest subjects, in visits of science research institutions, in seminars on the recent progress realized in some fields of science and technology, in demonstrations which illustrate the results of recent discoveries in science, ...

- seminar for junior scientists : different forms are possible :

a) senior scientists are invited to speak about their own works or about different aspects of science. Questions and a debate normally follow these lectures ; (some associations call this activity "science forum").

b) young people interested in science are gathered for one theme. They listen to communications presented by specialists, but they also present themselves lectures and also sometimes, science projects related to the chosen theme.

- Youth international seminars

Youth should be more and more closely associated in the planning and implementation of activities. Very early, all over the world, youth becomes fully aware of the role they are bound to play not only to ensure their own personal future, but also to contribute to the "better-being" of mankind. The community development programmes constitute a wonderful concrete application of this attitude.

The tangible results achieved on the occasion of the following youth international scientific seminars cannot but strengthen and corroborate this statement :

- international meeting held at Göteborg, Sweden, August 1971, on the theme "Youth and water pollution" ;

- the European Conference "Youth and Space" held at Merly-le-Roi, (France) in 1972 ; at Belgrade (F.S.R. of Jugoslavia) in 1973 and at Madrid (Spain) in 1975 ;
- an Asian youth seminar held at Thondaimanner, Sri Lanka (Ceylon) in August 1974, together with a science exhibition of science projects on the theme "Youth and environment : green revolution" ;
- each year, the London International Youth Science Fortnight gathers more than 400 young boys and girls, to help them have a better appreciation and understanding of the social implications and applications of science to the better-being of mankind (films, visits, seminars, conferences, lectures, ...) ;
- regional meetings are also organized to reach the same objective : to stimulate the participation in the development and coordination of out-of-school science activities ;

  e.g. : "the first South American meeting on Science and Youth", held at Olavarria, Rep. of Argentina, in September 1973 ;
- ...

Obviously, at this stage of our survey, it is practically impossible to determine the physics component in these youth congresses, meetings and/or seminars. Indeed, as for the science camps and training periods, those meetings are held on a largely pluridisciplinary basis.

But in order to answer better the needs and aspirations expressed by youth, we suggest the organization of youth seminars on regional and international level, of course following the financial possibilities, and on themes such as :

Youth and electronics
Youth and oceanography
Youth and cybernetics
Youth and ecology
...

Some examples of national youth science meetings

- in the framework of its annual meetings, the British Association - Young Scientists (BAYS) includes in its programme some debates-conferences on physics ; among the themes dealt with : "How to be a physicist and let others enjoy it ?"; radar and its applications ; computers in action ; ...

- the "Coordinatie commissie voor wetenschap buiten schoolverband" (coordinating commission for out-of-school science activities), in the Netherlands, organizes on a regular basis, since 1967, scientific days and week-ends on themes such as : energy, computers, pollution, ... Those days, gathering more or less 20 to 30 participants, are more and more designed to young people who as a whole do not deal with physics in their professional life ;

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- in Zambia, the winners of the regional science fairs organized by JETS are invited to take part in a two-day national congress during which they present their projects and reports. Then the best of them is chosen and elected the best young engineer of the year. This scientific congress has also a special section essentially devoted to physics sciences ;

- ...

2.1.4. Competitions and science fairs

It is a public exhibition of scientific works achieved by young people. They aim at giving them the opportunity to re-enforcing their confidence in their own means, establishing and verifying clever hypothesis, expressing themselves clearly and discussing with the visitors the questions related to the methods used to elaborate their project and the value of their conclusions.

These are indeed the main purposes looked for and expressed by the science fairs organizers :

- to promote the active interest for science and its applications among young people ;
- to bring to these young people a new educative experience by the oral explanations they are led to provide for senior scientists, other young people, and non-initiated adults ;
- to valorize publicly these young people not only to the school Institutions, but also to the local, regional, national or international community (according to the geographical extension of the sector concerned by the exhibition).

The achievement of the science projects is generally made in the frame of out-of-school activities, after the school hours, but often advised by teachers or other people, well-informed in science and technology. These fairs are limited to individual projects and/or to group projects. They may be organized at the local, regional, national or international level.

They have a competitive aspect in some countries, but not in other countries. The wish of the organizers of non-competitive fairs is essentially to encourage various categories of young people to achieve projects, simply because they want to do so, to help the young people to realize that science is something which is being done, that study is not sufficient, and that an expriment is made in order to verify something which is not necessarily known, and not exclusively to confirm an already known result by the reading of a handbook.

In the case of a competition, the projects are judged by a jury composed of experts, who generally appreciate more the original idea, the scientific content, the creative thinking that the visual presentation, the dramatic value and the completion details.

The young people present not only theoretical or abstract projects, but also projects related to the problems encountered by the community in which they live (e.g. project in relation with the air and water pollution). In all the countries of the world, and more particulerly in the developing countries, various projects are in close relation with the realities of the social and economic development (e.g. the comparison of the growth of food plants in various soils).

We may say that the science fair (competitive or not) has an important role in the developing countries, because young people participate directly in the dissemination of the scientific mind and knowledge in their community. (In particular, if the rural environment is considered, young people can contribute, to some extent, to the initiation of adults to the modern techniques of agriculture and breeding).

We are happy to be able to provide some figures relating to the physics component in the national and international exhibitions of scientific and technical projects achieved by young people :

- the "Al-Ahram Science Clubs" of the Arab Republic of Egypt have so far organized 4 science fairs, in which, an average 60 % of the projects were dealing with physics ;

- in one of the last Canada wide science fairs, out of a total of 134 projects presented, 35 were dealing with physics ;

- in the Federal Republic of Germany, at each annual science fair, an average of some 300 young people choose physics for the projects they present ;

- at the finals of the 4th annual science fair of Ghana, 5 out of the 12 winning projects were about physics ;

- every year, national competitions - "competition of the young technician", "Minitechnicus", ... - are organized in various socialist countries in Eastern Europe : USSR, Rumania, Jugoslavia, Hungary, Czechoslovakia, ... ; on such occasions, thousands of projects are presented in various fields relating to physics and technology (mechanics, electronics, electricity, model, radio, astronautics,...)

- the catalog with the projects presented all along the various competitions held between 1969 and 1973 by the Swiss Foundation "Science calling youth", shows that out of 278 projects allotted in 5 categories, 79 are listed under physics title ;

- 45 % of the projects presented at the "Scientific Forthnight" held annually at Ouagadougou, Upper Volta, by the Movement Youth and Science, deal with physics fields and themes ;

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- a regional exhibition held by the Science Foundation of the Philippines gathered 33 projects in physics-mathematics against 65 in biology-chemistry ;

- out of 48 projects presented in the framework of the "innovative activities study projects" of the National Science Teachers Association (NSTA) of the U.S.A., 17 dealt with physics ;

- the British Association Young Scientists (BAYS) notices that something like one-third of the projects presented during science fairs are directly correlated with physics themes and topics ;

- the Unga Forskare Foundation (Youth and Science), from Sweden, has published in 1973 a directory of 1.000 titles of science projects achieved by young people in 43 different scientific branches, in the context of Swedish science fairs. Out of those 1.000 projects, 758 were presented by secondary senior young people ; and out of those 758, 150 approximately were devoted to physics ;

- ...

Examples of international science fairs

The Science Service of the U.S.A. has organized in May 1975 its 26th international science fair, officially called the "International Science and Engineering Fair", - ISEF.

The same typical example has been registered in many other regions and continents, such as :

- a first Asian science fair held in 1968, at Bangkok, Thailand, by the "Science Clubs of Thailand", under the auspices and sponsorship of the "Science Society of Thailand" ;

- in Europe, a non-competitive science fair has been organized in 1971, 72 and 73 at Mainz, Fed.Rep. of Germany, by the Jugend Forscht Foundation ;

- the "first Science Fair of the Americas", held in Mexico city, in June 1973, was organized under the joint sponsorship of the "Consejo Nacional de Ciencia y Tecnologia" (CONACYT) in Mexico, and of two associations in the U.S.A. : the American Association for the Advancement of Science (AAAS) and Science Service ;

- and a wide ranging African project : the "African non-competitive science fair" to be held in Accra, Ghana, November 3 to 8, 1975, under the initiative of the Ghana Association of Science Teachers (GAST), which celebrates this year its 25th anniversary ;

- ....

2.1.5. Populer science centres - Museums.

Scientific and technological museums should no longer be conceived as mere collections of objects. Where they exist, they should become more and more closely integrated with the

educational and popular education systems.

Consequently, it is particularly important to seek out every means of transforming the existing science museums into "popular science centres", or to create such centres where activities like science clubs, exhibitions of scientific projects, competitions, courses, public lectures, loans of material, ... may be developed.

The too fragmentary information collected for this report leads us to express the wish to cooperate positively with other specialized organizations - we are referring more particularly to the International committee for scientific and technical museums of the International Council of Museums (ICOM) - in order to define means and ways to develop the educative action of the popular science centres (museums) and planetaria.

We do not intend to draw a list of the main science museums all over the world ; since indeed we would not like to omit any of them ; and moreover, the specialized association mentioned here above, has already done so, very successfully.

We would rather emphasize a special programme transmitted by India. This particular example could very well illustrate the idea defined by Mr. R.A. STEVENS, in his UNESCO handbook, already referred to "Out-of-school science activities for young people" (page 98 of the English version): " ... a science museum must not be just a monument ; on the contrary, it must be as living, live, changing, challenging, satisfying but unsatisfied as science itself".

In India, the main science museums and the planetaria are situated in the big towns. So, in order to apply the advantages of the museums and the audio-visual methods for the rural populations, the "Birla Industrial and Technological Museum (BITM)" of Calcutta has developed the idea of mobile museums. These travel through out the country, carrying science fairs. Demonstrators are responsible of these buses" ; they explain the exhibited projects, in simple words and in the local languages. By further improving the quality and quantity of these demonstrations, these "museobuses" can be an important instrument for the propagation of science among young country people and rural populations.

The BITM, has been set up, run and financed by the "Council of Scientific and Industrial Research", under the Ministry of Education of the Indian Government. The museum is located in Calcutta, with a population of some 400 millions inhabitants, and is operating its activities in this area and the adjoining regions.

The main objectives of this museum are to portray the history of science and technology with the help of permanent exhibitions, to create the scientific awareness among the lay public, and to complete the science education at school by means of audio-visual demonstrations.

To achieve the first objective, this museum has set up several galleries devoted to various branches of science and technology, such as : nuclear physics, mining, copper, iron and steel, petroleum, electricity, television and electronics, communications and transports, ...

The second objective is also achieved to some extent, thanks to the permanent exhibitions hold at the museum. However, this museum is visited mainly by the urban populations; to reach the rural populations, mobile exhibitions are organized.

The exhibits are mounted on a specially equipped "bus" which serves as the exhibition hall. In 1968, there were 4 mobile units, devoted among others to the following subjects; our familiar electricity, transformation of energy, light and sight, ...

The BIRLA Museum has also set up regional science museums in some district towns. (4 in 1969).

The third objective is achieved mainly by activities such as science demonstration lectures, creative ability centres, techer training programmes, film shows, ...

These programmes are organized at the headquarters at Calcutta, and also in the regional science museums. The purpose of these science demonstration lectures is to show to the school that science can be taught with the help of demonstration kits and such kits can be fabricated at cheap prices by students at school guided by their teachers (in the creative ability centres). To train teachers for these activities, teacher training programmes are organized at Calcutta and in the regional science museums.

A promotion centre for creative abilities has been set up at the BITM to encourage students to develop their scientific aptitudes by fabricating scientific devices and equipment. The museum also organizes yearly viva voce competitions and science fairs for students.

Another action initiatied and developed for rural areas is the establishment by the "National Council of Educational Research and Training" (NCERT) of science centres "Vijnan Mandirs" in various villages of India ; the purpose is to popularize science by demonstrations and its applications in the daily life.

These centres are mainly committed with problems of hygiene and health in rural districts. Generally, these centres keep up small museums with collections of local flora and fauna.

Unfortunately, the multiplication of the science centres is limited because of shortage of financial means and insufficiency of qualified people to keep them up.

Popular science centres or science museums have already been founded in many other developing countries.

We express the firm wish that a large and wide debate be held in order to define the basic questions, leading to a better understanding of the educative role of scientific and technical museums, on the basis of the qualitative and quantitative improvement of this remarkable working tool.

2.1.6. Scientific Olympiads.

The presentation we make of this form of science competition (physics, chemistry, mathematics, biology) is based almost exclusively on the experience acquired by the socialist countries of Eastern Europe.

The purpose of these competitions is to encourage students to increase their knowledge, to create conditions favourable to a non-directed work and to stimulate young science talents, helping their orientation to Higher Schools. In some countries, the winners of the national olympiads have access to university colleges, without entrance examination.

The participants are generally chosen among secondary schools and the last form of the higher primary schools. Considering the different stages of formation of the participants, the olympiads are often divided into various categories, in order to have a valid and objective classification.

For instance, for an olympiad designed for the students of the final forms of the secondary education, the competition was divided into three stages : local, regional, national. The candidates who succeeded in the local and regional competitions participate in the national olympiad, divided into two parts : a theoretical part (solution of original problem) and a practical part : practical work in laboratories, on a proposed theme, the same for all of them.

The winners are given the opportunity to attend special courses in the discipline they have chosen, in order to help continually the progressive and regular development of their capacities. They represent their country in the International Olympiad, organized every year in order to contribute to the development of the international relations and to multiply the exchanges of opinion in the field of science education.

We may add that higher courses of physics, chemistry, biology or mathematics are organized for the teachers of lower forms, so that they can cooperate in a better way to the preparation of their school children to the competition.

In a report prepared by a Member of the Central Committee of the international Physics Olympiads, we pinpoint that the objectives are to contribute to the development of international relations in order to raise up the level in physics teaching, to stimulate interest among students in secondary schools towards further studies into physics, and to create favourable conditions for exchanges of opinions about particular problems in this field.

The first international Physics Olympiad was held at Warsaw, S.R. of Poland, in 1967 and since then the international Physics Olympiad has been held annually, usually in the capital city of one of the socialist country in Eastern Europe.

There are forms of "competitions" ; for example : the Physics contest organized each year for more than half a century by the Hungarian "Eötvös Physics Society". In these contests, students from high school and college levels have to solve some physics problems about physics. The winners are of course rewarded. This contest provides the opportunity of detecting and encouraging talented students in physics.

Another type of olympiad is realized since 1967, by the Coordinating Commission for out-of-school scientific activities in the Netherlands (Coordinatie commissie voor wetenschap buiten schoolverband), that organizes an annual physics olympiad. For four years the concept of this contest did not change ; and then the pedagogical approach was modified : the organizers are now trying to attract and arouse the interest among young boys and girls (15 and 16 years old) not particularly talented in physics sciences, but on the contrary rather weak in this field ; the basic objective is now to introduce these young people into the social implications of physics sciences. At the same time, these olympiads have given up their competitive aspect.

2.1.7. Science talent search schemes

At a time of rapid progress in science and technology, the out-of-school education largely contributes to the scientific training of young people and to the promotion of enterprising minds which need more extensive knowledge and broader outlook.

The youth science talent search is more and more becoming a preoccupation of the responsible Authorities. After this stage of detection, all the possible opportunities must be given to these young people in order to develop their knowledge, and to stimulate their sense of creativity.

In order to identify the students endowed for science - generally speaking, these talents are detected during the secondary education - and to encourage them to continue studies in Colleges or large Science Schools, various national associations have set up programmes which foresee the attribution of scholarships and/or certificates of merit, to reward a certain number of selected students who have real abilities.

The winners are chosen on the basis of a national competition during which candidates present and defend a written report on a scientific subject. This competition generally takes place once a year. The best students have very often the opportunity to meet famous scientists and to present them their works. They are regularly associated to special science programmes which give them a new opportunity to check and enlarge their knowledge.

The other activities presented in this document - more particularly the olympiads and competitions, and the science fairs - include among their basic objectives the search and detection of science talented young people.

Other examples of "science talent search schemes" can be presented to the participants in the Conference : Brazil, India, Philippines, the U.S.A., ...

2.1.8. Diverse activities

- Science "quiz"

It is generally organized, either at a school level, or on a inter-school basis. The participants answer individually or in groups, questions connected with science subjects. Marks are given according to the value of the answers. Rewards are usually given to the individual winners or to the winning teams.

- Science visits

Science research institutions, industrial concerns, universities, ... invite groups of young people to visit their installations in order to give them a live picture of science and to illustrate by real examples the theoretical knowledge provided by the formal education. These visits often appear with the working programmes of the science clubs.

Groups of young people, surrounded by science advisers, are more and more practicing the "scientific tourism" on a national but above all international scale. During these science tours, they visit museums, science clubs, industrial installations, large laboratories, ...

2.2. Characteristics of the young participant

In the questionnaire we sent out to all our members and correspondents, two criteria were selected to try to find out a trough definition of the young boys and girls envolved in scientific and technical activities : their age and motivation(s).

Moreover, in the framework of our contribution to the International Women Year, we also asked the following question: what is the percentage of women's participation in the activities more particularly oriented towards physics ?

The following figures have been selected from the answers provided by 15 associations from 12 countries :

Young science associations in	average age	women's participation (physics groups)
Fed.Rep. of Germany	16 - 21	20 %
Belgium	13 - 19	-
Canada	12 - 19	few
A.R. Egypt	18	40 %
Ghana	9 - 21	40 %
Great Britain		
science fairs	5 - 19	25 %
science Fortn.London	17 - 22	-

./..16

Young science associations in	average age	women's participation (physics groups)
Upper-Volta	19	few
India	16	20 %
Israël	16 - 18	20 %
Senegal	13 - 25	few
Jugoslavia	13 - 18	-
Zambia	secondary level	-

The general tendency drawn from the numerous experiences and long before the collection and study of the questionnaire mentioned here above, is that the age of those concerned with these activities becomes younger and younger, without any diminuition in the intellectual level or the results achieved - in fact the contrary is the case.

This attraction for very young participants, this breakthrough of science and technology to the very young is an extremely important phenomenon. Many organizers have found that in imagination and experimentation there is little difference between 11 and 18. More than their older brothers and sisters, the very young expect a strong swing away from formal teaching towards the out-of-school approach, and ask to be integrated into teams where they can take the initiative and responsibility, and acquire knowledge by doing their own thing. They show considerable flexibility of interest as between subjects, places of work, study and research.

Among the motivations stimulating young people to achieve and carry out physics activities, we can emphasize :

- orientation towards professional life, considering the wideranging possibilities offered by physics ;

- wish to start physics studies and investigation at university ;

- "hobby" that enables them to achieve a practical activity and satisfies their scientific curiosity ;

- research in the practical applications of physics to the community development ;

- ...

Those motivations are listed without any priority order, since indeed, at the present stage of our inquiry, we cannot possibly determine their relative importance, for youth in the Third World as well as for youth in more industrialized countries, for example.

2.3. Characteristics of the science leader

The observations synthetized here below result from the analysis of a first group of answers to the questionnaire provided by 15 associations from 11 countries, to the two following questions :

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a) what is the average age of the science leader ?

b) what is his level and/or specialization from the scientific as well as pedagogical points of view ?

These few examples concern the science leader in the following countries : Fed.Rep. of Germany, Canada, A.Rep. of Egypt, Ghana, Great Britain, Upper-Volta, India, Israel, Senegal, Jugoslavia, Zambia.

The average age does not vary much from one country to another : a large majority has more or less limited the leader's age between 25 and 35, though without overlooking the role of older leaders of sometimes 60 and even more.

In most cases, the leadership in youth science movements is ensured by teachers of college level having been trained either in the superior or secondary teaching. But sometimes, the associations also have non-university and primary teachers, depending on the level of young participants to whom the programmes are designed. Very often, the investigators and scientists working in scientific institutions and the engineers are also asked to take a leading role in the associations of young scientists and technicians. Nowadays, there is also a very clear tendency that shows the envolvement of students in the university faculties to strengthen the pedagogical and scientific leadership of these activities.

2.4. Pedagogical support

2.4.1. Written material

- many organizations of young scientists publish periodicals for their members. In our mind, this sort of written document deals with science as a whole - consequently also with physics - but very few are exclusively devoted to physics sciences. A list of these publications could be prepared by ICC, if the members of the working group convened at Edinburgh want it ;

- another example should be largely followed : the "Conseil de la Jeunesse Scientifique du Québec", Canada, has published in the early 1975, a directory of books and periodicals accessible to young scientists ; 25 % of the books and nearly 50 % of the periodicals deal with physics topics. This inventory list 1831 volumes and books and 160 periodicals ;

- on the other hand, for their typical physics activities, several associations provide their members with information on physics in leaflets or handbooks. This type of information helps youth achieve his science project, or solve a theoretical problem (e.g. in the olympiads), or prepare a practical experiment in laboratories, ... ;

- following the information collected, it seems that the books used as reference, for instance in the science clubs libraries, are more often than not the books also used in the formal education ;

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- the ICC international journal : "Out-of-school scientific and technical education", published with the assistance of UNESCO, in 4 editions (English, Arabic, Spanish and French), has already issued in its "pedagogical notes", two files specially devoted to physics :

1) "How to design, construct and test a rocket" : project development (detailed study and mock-up construction ...) ; description of a "rocket-motor and igniter (propellant block, ignition relay, safety factor, centres of gravity locations, ...) ; typical telemetry system ; equipment of an electronics laboratory ; ...

2) "How to establish and run an astronomical club" : clubs, the leader ; where and how to meet?; how to organize the club ? ; how and where to begin ? ; the choice of methods ; material recommended ; the cost of material ; suggestions for activities when observation is possible and when it is not possible ; bibliographical references ; ...

- ...

2.4.2. Science "Kits"

Science must be a form of play, and, at the elementary level, it is not necessary to use elaborate material. The science kit, usually a box containing rather elementary material, is sufficient to be a valuable auxiliary in a classroom or club. There are self- contained experimental kits (e.g. a microscope), thanks to which the younger people can familiarize themselves with the observation and experimentation methods.

Here are some typical examples of such kits ; this list does not intend therefore to be exhaustive :

- the Brazilian Foundation for Education and Culture, FUNBEC, Sao Paulo, produces kits about various scientific branches in general and consequently including physics. These kits are autonomous units, containing both the material for the practical experiment and a text, to be directly used by the young scientists. The FUNBEC has already produced more than 30,000 kits about more or less one hundred different topics in physics. Some titles chosen from the catalog : how to construct a battery ? ; what is an electric motor ? ; the polarized light ; the rainbow (for children of 7 to 9 years) ; electricity explained to children (8 to 12 years) ; ...

It should be added that some of these kits are exported and consequently, the written explanations in the texts are translated into several languages ;

- the programme "Things of science" of the Science Service in the U.S.A., enables young people from 10 to 16 years old, to carry out very simple and safe experiments at home. These kits are distributed on a monthly subscription basis ;

- the Birla Industrial and Technological Museum (BITM), Calcutta, has conceived, produced and distributed some demonstration units about physics. A special service to loan these physics kits has been set up ;

- the JETS Association in Zambia has launched since 1971 a special programme "Production-Technology" : the ZAMKIT project has led to the implementation of voltmeters and other measuring instruments, made of spare parts and elementary material the members of the club had at their disposal ;

- ...

Many other associations produce or use science kits. But, it is quite clear that kits do not form the basic scientific and technical equipment of clubs. We can briefly add that many associations use the existing school facilities, especially in periods when school is closed (week-ends, holidays,...). Universities and industrial centres often open the doors of their laboratories providing then talented young people with new opportunities to learn. Some national public services do also put some material at the disposal of clubs : Post, Telegraph and Telephone ; Transports ; Energy ; Education and Culture, ...

2.4.3. Mass Media (films, audio-visual aids, radio and T.V. programmes).

Several UNESCO conferences and seminars have emphasized the impact mass media can have in the promotion of public understanding of science and technology. This becomes even more concrete at a time when telecommunication satellites are more and more used to meet educational needs.

During the biennium 1973-1974, our international organisation has been associated to the working programme of the UNESCO Division of Methods, Materials and Techniques. Under a contract, ICC has been requested to :

"produce a descriptive and annotated directory of significant examples of mass media (films, audio-visual aids, radio and television programmes, ...) used to develop scientific appreciation and promote a technological creative imagination among young people (school teaching material and programmes being excluded)..."

It is also stipulated in the contract that the directory must contain "all necessary information to buy, rent or borrow this material".

After a first inquiry, a working document "Mass Media and scientific mind among young people" transmitted to UNESCO, presents the following results :

27 production companies located in
18 countries,
present
83 programmes
produced all together in
36 different languages.

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And out of the production mentioned here above, some 25 % deal with pure or applied physics.

This inquiry is an attempt to answer the problem : how to arouse young people's interest towards science and technology through the increasing rational use of mass media ?

We have somehow cleared out a part of the way, and found out new paths, leading us to the following synthesis :

- beyond this first essay of directory, we have made up a card-index, with more than 400 societies, associations and individuals, directly concerned by the questions tackled in our inquiry.

Those references are of course not stored for the only purpose of our international organization ; they are at the entire disposal of UNESCO, and all other international or national organizations, and persons interested in the field ;

- moreover, the catalogues gathered at the General Secretariat could be used for a further investigation, with new defined objectives, if UNESCO or any other international Organization wants to extend its inquiries and reflections on the educative and ever increasing social rôle of mass media.

This extending rôle of mass media in school and out-of-school education, is illustrated in the achievements of many of our members and correspondants, e.g. :

- the "Conseil de la Jeunesse Scientifique", Québec, has recently published a directory of films accessible to young scientists in which 125 films out of the 464 listed deal with different fields of physics sciences ;

- the science clubs in Egypt produce a series of slides ; a weekly T.V. programme is devoted to the clubs activity;

- the National Council for Educational Research and Training (NCERT), in India, animates among others radio programmes for the popularization of science ;

- ...

Many other examples of the extending utilization of mass media in the educational process could be presented, in industrialized countries as well as developing nations. But, besides those means, which require a strong technical infrastructure and consequently important investments, we must emphasize the positive role played by traditional cultural vehicles, specially in countries of the Third World : puppet-shows, shadow plays ; cartoons, posters, ... can very helpfully contribute to the scientific and technical literacy of youth and adults.

3. MAIN DIFFICULTIES ENCOUNTERED IN THE DEVELOPMENT OF OUT-OF-SCHOOL EDUCATION AND SUGGESTIONS TO SOLVE THESE PROBLEMS

3.1. Youth's attitude facing science

Some considerations about the conditions ruling the development of out-of-school science education in countries of the Third World, lead us to the following observation : it seems fundamental to orientate youth in these countries towards a critical, analytical and logical scientific attitude. The first objective to attain must be the demystification of science, getting rid of this "supernatural" aspect. Indeed, scientific activities must extend and develop in a context of objective analysis and logical observation.

But in other regions of the world - for example the countries from the Western hemisphere - youths are wondering : they are far from being convinced that science is keeping fine. Nobody denies the "science crisis" : science and technology have actually brought in our lives many material advantages, but they do not necessarily improve the quality of life.

In this particular frame of mind, it would be advisable for the ICPE working group to tackle some topics of growing social importance : rationality of science and technology ; neutrality of science ; the scientist's responsibility ; ...

3.2. Selection and training of leaders

In the framework of various "UNESCO seminars on the promotion of public understanding of science and technology", there has been a number of requests for the organisation of international training courses for leaders. We are a little cautious about this, firstly because conditions vary so much from one country to another and one region to another, and also because such international courses are terribly costly. It would seem that perhaps it is more logical and more feasible to start by thinking in terms of extending national programmes of training leaders, which would probably be supported financially by the governments concerned, and which would also contribute largely to the institutionalization of scientific literacy programmes in the countries concerned.

Then, perhaps through such aid programmes of UNESCO as the Fellowship Programme, these training courses could be enlarged to cover a sub-regional or regional area. Grants could be offered to leaders chosen by governments to study in other countries methods used for out-of-school scientific and technical activities, and the promotion of public understanding of science and technology, and training methods.

3.3. Insufficiency in the scientific equipment and pedagogical support

This urgent need of equipment has been emphasized in several national reports we received. These insufficiencies

vary considerably from one region of the world to another, and from one area to another (urban or rural areas), ...

Most of all, we would suggest to make more rational use of the existing resources ; since indeed, materials used in physics experiments are usually very expensive :

- utilization of school equipment for out-of-school activities, education being indeed a permanent process ;

- extension of the role to be played by universities, other scientific institutions, scientific end technological museums or popular science centres, ... in the scientific information and training of young people ;

- ...

3.4. Unequal dissemination and insufficiency in the means of information

Some national or regional monographs express the necessity to create or develop the conditions of the scientific environment, and lead to some suggestions for possible solutions :

- the seminars and working groups convened in 1969 at Sao Paulo (Brazil) and Cordoba (Argentina), in 1970 at New Delhi (India) and Nice (France), in 1971 at Lusaka (Zambia) and in 1972 at Manila (Philippines) have definitely emphasized the urgent need to publish national, regional and international popular science journals ;

- fixed and mobile science fairs, science libraries, mass media and traditional cultural vehicles, ... also play an important and even sometimes priority role ;

- ...

3.5. Problem of languages

In many cases, the age at which secondary school students become sufficiently proficient in French or English (as the case may be), really to benefit from science teaching in those languages is often 16 or 17, and this is far too late for the education requirements.

Using local languages for science teaching must start at the earlier possible age, because this is the formative age and the age of receptivity ; hence attempts to approach science must be conducted in local languages.